CLAIMS

What is claimed is:

1. A jet engine for a mobile platform, the engine comprising:

a nozzle rim;

a bendable duct for communicating an exhaust flow generated by the engine to the nozzle rim; and

a gimbal joint pivotably coupling the nozzle rim to supporting structure to allow pivoting of the nozzle rim about a first axis and a second axis for changing a vector at which the exhaust flow is discharged from the nozzle rim.

2. The engine of claim 1, wherein the gimbal joint comprises a gimbal ring pivotably coupled to supporting structure to allow pivoting of the gimbal ring relative to the supporting structure, and pivotably coupled to the nozzle rim to allow pivoting of the nozzle rim relative to the gimbal ring.

3. The engine of claim 2, wherein the nozzle rim defines a pair of curved flanges each of which is pivotably coupled to the gimbal ring.

4. The engine of claim 2, wherein the nozzle rim is pivotably coupled to the gimbal ring with a second gimbal ring.

5. The engine of claim 1, wherein the gimbal joint comprises:

an outer gimbal ring pivotably coupled to supporting structure to allow pivoting of the nozzle rim about the first axis; and

an inner gimbal ring pivotably coupled to the outer gimbal ring and coupled to the nozzle rim, the inner gimbal ring allowing the nozzle rim to be pivoted about the second axis.

6. The engine of claim 1, wherein the first axis is generally perpendicular to the second axis.

7. The engine of claim 1, further comprising an actuation system for controllably pivoting the nozzle rim.

8. The engine of claim 7, wherein the actuator system includes:

a first actuator yoke plate for pivoting the nozzle about the first axis; and

a second actuator yoke plate for pivoting the nozzle about the second axis.

9. The engine of claim 8, wherein each said yoke plate includes:

a first end pivotably coupled to supporting structure;

a second end defining gear teeth engaged with a corresponding actuator gear; and

a pair of arms defining an opening and extending about the nozzle rim, the arms including bearing surfaces for transmitting lateral forces to the nozzle rim while permitting sliding contact with the nozzle rim.

10. The engine of claim 1, wherein the bendable duct is convoluted.

11. A mobile platform comprising the engine of claim 1.

12. A nozzle for a jet engine, the nozzle comprising:

a nozzle rim;

a bendable duct for communicating an exhaust flow generated by the engine to the nozzle rim; and

at least one gimbal ring pivotably coupled to supporting structure and to the nozzle rim to allow pivoting of the nozzle rim about a first axis and a second axis for changing a vector at which the exhaust flow is discharged from the nozzle rim.

13. The nozzle of claim 12, wherein the nozzle rim defines a pair of curved flanges each of which is pivotably coupled to the gimbal ring.

14. The nozzle of claim 12, wherein the nozzle rim is pivotably coupled to the gimbal ring with a second gimbal ring.

15. The nozzle of claim 12, wherein the first axis is generally perpendicular to the second axis.

16. The nozzle of claim 12, further comprising an actuation system for controllably pivoting the nozzle rim.

17. The nozzle of claim 16, wherein the actuator system includes:

a first actuator yoke plate for pivoting the nozzle about the first axis; and

a second actuator yoke plate for pivoting the nozzle about the second axis.

18. The nozzle of claim 17, wherein each said yoke plate includes:

a first end pivotably coupled to supporting structure;

a second end defining gear teeth engaged with a corresponding actuator gear; and

a pair of arms defining an opening and extending about the nozzle rim, the arms including bearing surfaces for transmitting lateral forces to the nozzle rim while permitting sliding contact with the nozzle rim.

19. The nozzle of claim 12, wherein the bendable duct is convoluted.

20. A mobile platform comprising the nozzle of claim 12.

21. A method of operating a jet engine, the method comprising:

using the jet engine to generate an exhaust flow;

communicating the exhaust flow through a bendable duct to a nozzle rim pivotably coupled to supporting structure with a two-axis gimbal joint;

discharging the exhaust flow from the nozzle rim; and

controllably pivoting the nozzle rim to change a vector at which the exhaust flow is discharged from the nozzle rim.

22. The method of claim 21, wherein the controllably pivoting comprises one or more of:

pivoting the nozzle rim about a first axis; and

pivoting the nozzle rim about a second axis generally perpendicular to the first axis.

23. The method of claim 22, wherein:

pivoting the nozzle rim about a first axis includes pivoting a gimbal ring pivotably coupled to the supporting structure and the nozzle rim relative to the supporting structure; and

pivoting the nozzle rim about a second axis includes pivoting the nozzle rim relative to the gimbal ring.

24. The method of claim 22, wherein:

pivoting the nozzle rim about a first axis includes pivoting an outer gimbal ring pivotably coupled to the supporting structure relative to the supporting structure; and

pivoting the nozzle rim about a second axis includes pivoting an inner gimbal ring coupled to the nozzle rim relative to the outer gimbal ring.

25. The method of claim 22, wherein the controllably pivoting comprises:

actuating a first actuator yoke plate to pivot the nozzle about the first axis; and

actuating a second actuator yoke plate to pivot the nozzle about the second axis.

26. A method of providing a jet engine with a thrust vectoring nozzle, the method comprising:

pivotably coupling a nozzle rim to supporting structure with a two-axis gimbal joint; and

coupling a bendable duct to the nozzle rim and the engine for communicating an exhaust flow generated by the engine to the nozzle rim.

27. The method of claim 26, wherein the pivotably coupling comprises:

pivotably coupling at least one gimbal ring to supporting structure; and

pivotably coupling the nozzle rim to the gimbal ring.